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10/646,709	08/25/2003	Sadayuki Ohnishi	Q76993	9821

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EXAMINER

CAO, PHAT X

ART UNIT	PAPER NUMBER
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2814

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/08/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/646,709

Applicant(s)

OHNISHI, SADAYUKI

Examiner

Phat X. Cao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 01 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 and 25-35 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 and 25-35 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1-13 and 25-26 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

- In amended independent claim 1 filed on 11/9/05, lines 1-2, a phrase "...a semiconductor substrate which acts as a first copper diffusion barrier layer" is not supported by the original disclosure. For example, Fig. 4 of Applicant's invention discloses a dielectric film 100 formed on a semiconductor substrate (not shown, see Fig. 13), made of SiCN, and having a dielectric constant $k = 4.8$ (see Applicant's specification, page 10, line 17 and page 11, line 22). The SiCN dielectric film 100 serves as a first copper diffusion barrier layer (see Applicant's specification page 10, line 17), but not the semiconductor substrate as amended. Therefore, having a semiconductor substrate functioning as a first copper diffusion barrier layer is not supported by the original disclosure.

- Dependent claims 2-13 are also rejected because they depend from amended independent claim 1.

- In amended claim 25 filed on 5/31/05, having both 1) "an adhesive film constituted essentially by a silicon-based compound ... and a low dielectric constant film constituted essentially by an organic low dielectric constant material ... contacting said adhesive film" and 2) "a second adhesive film constituted essentially by a silicon-based compound ... is formed between a SiCN layer and said low dielectric constant film" are not supported by the original disclosure.

For example, in Fig. 6A of Applicant, if assuming that BCB film 110 is "an adhesive film" or a first adhesive film, BCB film 120 is "a second adhesive film", SiCN layer 100 is "a SiCN layer", and MSQ film 102 is "a low dielectric constant film" or "**said** low dielectric constant film", then Fig. 6A shows that "a second adhesive film [120] constituted essentially by a silicon-based compound ... is formed between a SiCN [100] and **said** low dielectric constant film [102]". However, Fig. 6A does not show "an adhesive film [110] ... and a low dielectric constant film [102] ... contacting said adhesive film [110]" because "**said** low dielectric constant film [102]" clearly does not contact "said adhesive film [110]".

- In amended claim 26 filed on 5/31/05, having both 1) "an adhesive film constituted essentially by a silicon-based compound ... and a low dielectric constant film constituted essentially by an organic low dielectric constant material ... contacting said adhesive film" and 2) "a second adhesive film constituted essentially by a silicon-based compound ... is formed between a SiO and said low dielectric constant film" are not supported by the original disclosure.

For example, in Fig. 6B of Applicant, if assuming that BCB film 110 is "an

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adhesive film” or a first adhesive film, BCB film 121 is “a second adhesive film”, SiO layer 107 is “a SiO layer”, and MSQ film 102 is “a low dielectric constant film” or “**said** low dielectric constant film”, then Fig. 6B shows that “a second adhesive film [121] constituted essentially by a silicon-based compound ... is formed between a SiO layer [107] and **said** low dielectric constant film [102]”. However, Fig. 6B does not show “an adhesive film [110] ... and a low dielectric constant film [102] ... contacting said adhesive film [110]” because “**said** low dielectric constant film [102]” clearly does not contact “said adhesive film [110]”.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 27, 29-30, and 32-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barth et al (US. 2004/0173908) in view of Lee (US. 2003/0067077).

Regarding claims 27 and 29-30, Barth (Fig. 1) discloses a semiconductor substrate 10, and a metal wiring 15 and an interlayer dielectric film (17,18,19) which are formed on the semiconductor substrate 10, the interlayer dielectric film (17,18,19) including a multi-layered structure consisting of: a diffusion barrier film 17 preventing diffusion of the metal out of the metal wiring 15 (par. [0006], last 3 lines), an adhesive film 18 (par. [0007]) formed directly on the diffusion barrier film 17, and a low dielectric constant film 19 of polymeric thermoset material (i.e., SILK) (par. [0008], lines 1-7)

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formed directly on the adhesive film 18, and the low dielectric constant film 19 (or 119 in Fig. 2) being constituted essentially by an organic low dielectric constant material having a specific dielectric constant not greater than 4 (par. [0031]).

Barth does not disclose that the adhesive film 18 is a silicon-based compound of BCB having an aromatic ring.

However, Lee (Fig. 11) teaches an interlayer dielectric film formed on a metal wiring 116a, the interlayer dielectric film including: a lamination consisting of an adhesive film 118 constituted by a silicon-based compound of benzocyclobutene (BCB) having a benzene ring (aromatic ring) in its molecule (par. [0019]), and an organic low dielectric constant film 120 having a specific dielectric constant not greater than 4 (pars. [0014] and [0021]) formed directly on the adhesive film 118. Accordingly, it would have been obvious to form the adhesive film 18 of Barth with the material as set forth above because as taught by Lee, such BCB adhesive layer would provide a good adhesion to the metal wiring layer/organic dielectric layer and would prevent a crack issue (par. [0019]).

Regarding claims 32-34, Barth further discloses that the organic low dielectric constant material 19 (Fig. 1) or 119 (Fig. 2) is a silicon-containing organic compound of methylsilsequioxane or SiOC (par. [0031]).

Regarding claim 35, Barth's Fig. 1 also discloses the interlayer dielectric film (17,18,19) is formed on the metal wiring 15.

3. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Barth et al and Lee as applied to claim 27 above, and further in view of Applicant's admitted prior art.

Barth discloses the diffusion barrier film 17 being made of SiN (par. [0006], last 3 lines), but does not disclose the diffusion barrier film 17 being made of SiCN.

However, Applicant's admitted prior art (Fig. 3) teaches the contact structure including a diffusion barrier film 108 of SiCN formed on a metal wiring 106. Accordingly, it would have been obvious to substitute SiN with SiCN because they both have the same function as a diffusion barrier film for preventing diffusion of the metal out of the metal wiring.

4. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Barth et al and Lee as applied to claim 27 above, and further in view of Lauterbach et al (US. 6,313,517).

Neither Barth nor Lee disclose that the silicon based compound is a polymer formed through polymerization of a monomer containing a divinylsiloxane bisbenzocyclobutene unit.

However, Lauterbach (column 3, lines 50-66 through column 4, lines 1-16) teaches the forming of an adhesive BCB, the adhesive BCB is a polymer silicon-based compound formed through polymerization of a monomer containing a divinylsiloxane bisbenzocyclobutene unit. Accordingly, it would have been obvious to form the BCB polymer layer of Lee with a BCB polymer containing a divinylsiloxane bisbenzocyclobutene because such BCB polymer would provide a good adhesion to

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semiconductor, oxide, nitride and metal layers, as taught by Lauterbach (column 4, lines 8-14).

Response to Arguments

5. In response to the rejection of claims 1-13 under 35 U.S.C. 112, first paragraph, Applicant argues that the limitation of having “a semiconductor substrate which acts as a first copper diffusion barrier layer” is supported by the original disclosure because “the SiCN layer 100 shown in Figure 4 is an embodiment of a semiconductor substrate which acts as a first copper diffusion barrier layer” (Applicant’s remark at page 10).

The examiner disagrees. It is noted that a person of ordinary skill in the art would not consider the SiCN insulating layer 100 ($K=4.8$) being a sublayer of “a **semiconductor** substrate” because the SiCN insulating layer 100 is an insulator but not a semiconductor as claimed.

In response of the rejections of claims 25-16 under 35 U.S.C. 112, first paragraph, Applicant argues that the subject matters of claims 25-26 are supported by Figs. 6a and 6b when assuming “a second adhesive film” is a BCB layer 102, “said low dielectric constant film” is an MSQ layer 102, and “a SiCN layer” is a SiCN layer 100.

The examiner disagrees. Fig. 6a does show that “a second adhesive film [120] ... is formed between a SiCN layer [100] and **said** low dielectric constant film [102]”. However, Fig. 6a does not show “an adhesive film [110] ... and a low dielectric constant film [102] ... contacting said adhesive film [110] as recited in claim 25 because “said low dielectric constant film [102]” clearly does not contact “said adhesive film [110].

Similarly, Fig. 6b does show that “a second adhesive film [121] ... is formed between a SiO layer [107] and **said** low dielectric constant film [102]”. However, Fig. 6b does not show “an adhesive film [110] ... and a low dielectric constant film [102] ... contacting said adhesive film [110]” as recited in claim 26 because “**said** low dielectric constant film [102]” clearly does not contact “said adhesive film [110]”.

Regarding the combination between Barth and Lee, Applicant argues that it would not be obvious to substitute the adhesion promoter layer 18 of Barth with the adhesion promoter layer 118 of Lee because Lee's Fig. 11 discloses the organic low dielectric constant material 120 disposed on the adhesion promoter layer 118 but not disclose the SiN cap layer disposed under the promoter layer 118 as disclosed by Barth's Fig. 1.

This argument is not, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Barth's Fig. 1 teaches the use of the adhesion promoter layer 18 for increasing the adhesion to upper organic low dielectric constant material 19 (i.e. SILK). Lee's Fig. 11 also teaches the use of the adhesion promoter layer 118 for increasing the adhesion to upper organic low dielectric constant material 120 (i.e., SILK). Therefore, one of ordinary skill in the art would be motivated to substitute the adhesion promoter layer 18

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of Barth with the adhesion promoter layer 118 of Lee because of their equivalence for their use in the semiconductor art as the adhesion promoter layers for promoting the adhesion to the upper low dielectric constant material and for preventing a crack in the interlayer dielectric structure, as taught by Lee (par. [0019], last 4 lines).

Regarding claim 33, Applicant argues that the organic dielectric layer 120 of Lee is not a silicon-containing organic compound because the organic dielectric layer 120 comprises spin-on polymer, such as FLARE, SILK, PAE-II, Velox, etc., or spin-on glass (par. [0021]).

This argument is not persuasive because FLARE and SILK are polymer materials which are silicon-containing organic compounds. Furthermore, Barth also teaches the organic dielectric layer being a silicon-containing organic compound of methylsilsesquioxane or SILK (par. [0031]). Therefore, both Barth and Lee do suggest the organic dielectric layer as claimed.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is 571-272-1703.

The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PC
February 2, 2007



PHAT X. CAO
PRIMARY EXAMINER